RSC Response to the House of Lords Science and Technology Committee
“Call for Evidence: Higher Education in STEM Subjects”.

The RSC welcomes the opportunity to respond to the House of Lords ‘Call for Evidence: Higher Education in STEM Subjects’ and our comments are summarised below.

Key Points

- At school level, the upturn in numbers following a pathway involving chemistry at A-level must be maintained; in this regard it is essential that drivers of HE choice (such as the AAB+ policy) do not result in unintended outcomes such as choosing non-STEM subjects
- The reforms of HE funding require careful monitoring - as well as the potential to affect student choice, policies such as the ‘20000 margin’ also have the potential to affect the ability of universities to support STEM subjects that require costly laboratory infrastructure and running costs; taken together, there is the potential to seriously damage the teaching of undergraduate science and to damage the skills pipeline.
- A geographical mix of flexible approaches to study needs to be encouraged and maintained
- A strategy for postgraduate training in the chemical sciences that involves all stakeholders is urgently required

1. What is the definition of a STEM subject, and a STEM job?

The chemical sciences form a core discipline within the STEM umbrella, which requires the developing of hypotheses, predicting, planning, gathering evidence, testing, interpreting and drawing conclusions. The chemical sciences are further targeted towards the invention, design and synthesis of new materials with specified properties, and the development of new techniques and methodologies both to construct new materials and to analyse and measure materials in a range of matrices with ever more sensitivity and lower levels of detection. The chemical sciences develop an understanding of the world in which we live from an atomic and molecular viewpoint, and, drawing on the development of new knowledge and understanding of the properties of substances and the interactions between different types of matter and analytical and problem-solving skills, help us to tackle societal problems such as health, energy, climate change, resource efficiency, food and water supply and so on. For example, chemistry is at the forefront of medicine, not only designing and creating novel therapeutic but also in developing diagnostic techniques to detect ill health.

The definition of a STEM job should include the following points: a STEM job will require core STEM competencies, a STEM related job would prefer the skills acquired by a STEM graduate compared to other skill sets, and finally a non-STEM job gives no preference or priority to a STEM graduate.

2. Do we understand demand for STEM graduates and how this could be used to influence supply?

The importance of producing sufficient numbers of highly skilled STEM graduates is vital to ensuring the UK’s future competitiveness on the world stage. Figure 1 demonstrates that the number of physical sciences graduates who are employed six months after completion of their degree is at least 90%. Moreover, 80% of physical sciences graduates of the 2006/7 academic year indicated that their education was an important factor in obtaining employment or helping them to carry out their required duties (Figure 2).

An economic study of the benefits of chemistry research to the UK[1] demonstrated that it contributed 21% to GDP (£257bn). Areas that rely on such research, and therefore on graduate chemists, include the chemistry-producing industries that manufacture chemicals and chemical products, including basic chemicals, (such as dyes and pigments, rubber, plastics, and fertilisers), pesticides, paints, varnishes, pharmaceuticals, soap and detergents, and synthetic fibres, and the chemistry-utilising industries such as the aerospace, automotive, electronics, health and textiles industries. Given the ongoing need for innovation in areas such as pharmaceuticals, energy, smart materials, nanomaterials, the low carbon economy, resource efficiency, food production, diagnostics for health and security etc., the demand for graduates of the chemical sciences is only going to increase.

The analytical, problem-solving, data handling and communication skills that are essential to the education of chemists, and more generally STEM graduates, have value for a wide range of careers, not simply those that utilise subject knowledge directly. The percentage of STEM graduates in a range of industries is shown in Figure 3.

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[1] The Royal Society of Chemistry, 2010, *The Economic Benefits of Chemistry Research to the UK.* http://www.rsc.org/images/Economic_Benefits_of_Chemistry_Sep_2010_tcm18-191337.pdf

3. Are schools and colleges supplying the right numbers of STEM graduates and do they have the right skills to study STEM first degrees?

The number of people studying chemistry at GCSE, AS and A-Level has been consistently increasing over the last 6 years. At GCSE level, the number studying chemistry as a single subject has increased from just under 57,000 in 2006 to almost 142,000 in 2011. The number of students studying chemistry at AS-level chemistry has increased from around 51,000 in 2006 to just less than 80,000 in 2011. And, in 2011 more than 48,000 thousand students studied chemistry at A-level, compared to 40,000 in 2006. This increase corresponds to similar increases in other STEM subjects (Figure 4). In Scotland, there have been similar increases in the numbers of students taking chemistry at Higher and Advanced Higher levels: in 2006, 9200 studied at Higher level and 2000 at Advance Higher; the corresponding numbers for 2011 were 10300 and 2500, respectively.

The numbers of applications and acceptances to study for a chemistry degree at university have shown modest increases over recent years (Figure 5). In 2010, the number of students accepted to study a chemistry degree or other undergraduate chemistry study was 4760. The ratio of applications to acceptances is currently 5.2. Chemistry is also an essential, or highly desirable, A-level for many other disciplines including, *inter alia*, pre-clinical medicine, veterinary science, and dentistry, pharmacy, chemical engineering and biochemistry; so, alongside those studying chemistry, at least another 16000 or so are using their A-level chemistry directly for higher education study.

There is a general feeling in the community that, while there are some high quality, very able students on undergraduate chemistry courses, two areas of knowledge are consistently raised as being particularly weak with regard to first year undergraduates: mathematics and practical skills.

4. What have been the effects of earlier government initiatives on the uptake of STEM subjects at advanced level?

The number of students studying chemistry at A-Level has increased consistently since 2003 (Figure 4). To assign this increase to one particular factor is difficult. One factor is likely to be the increased opportunity for students to study chemistry as a single subject at GCSE level. Another is the AimHigher programme. Additionally, the HEFCE/HEFCW-funded *Chemistry for our Future* and *HE-STEM* programmes are other potential factors.

In addition, the current economic climate and the increase in tuition fees are further factors that appear to be having a major impact on subject decision; students (and/or their parents) are choosing, and subsequently investing in, study paths that are likely to give themselves the best opportunities for employment.

5. What effect if any, will the English Baccalaureate have on the study of STEM subjects in higher education?

In 2010, 70% of maintained schools entered students for a GCSE in the three separate sciences; it is unlikely that the English Baccalaureate (EB) will incentivise schools to drive the take up of the separate sciences any further. The current trend for students taking the separate sciences at GCSE level is highly positive. However, the EB requires only two science grades. This is a concern, because timetabling pressures could well end up reducing the numbers of pupils taking GCSEs in all three separate sciences. If this were to result in a student studying no chemistry whatsoever at GCSE level the RSC would have serious cause for concern.

6. Is the current number of STEM students and graduates (from the UK, EU and overseas) sufficient to meet the needs of the industry, the research base, and other sectors not directly connected with STEM?

The RSC is pleased that the number of chemistry students in higher education increased in 2010 by 10.4%, to 4,290, more than any other core science increase. Moreover, physical sciences graduates are highly employable; a poll conducted by the Department of Business Innovation and Skills found that employers currently are struggling to find enough STEM graduates, and that this problem is set to get worse. A major reason for this shortage of STEM graduates is that they are enthusiastically recruited by non-STEM career sectors due to their highly desirable skill sets (Figure 3). With such demand it is vital that we continue to pursue ways to increase the number of students studying chemistry and other STEM subjects. It is worth noting in relation to the size of the graduate cohort, that approximately 1,000 chemistry postgraduate research students are recruited each year of whom some 675 are UK-based, and the Training and Development Agency for Schools has set recruitment targets for trainee chemistry teachers of just over 1,000 in both 2011 and 2012. Together, just these two areas account for some 40% of the annual cohort.

A significant worry is that as the percentage of overseas students studying STEM subjects is quite high (39%) if they decide to return to their home country to work rather than stay in the UK, this would leave UK businesses vulnerable.

7. Is the quality of STEM graduates emerging from higher education sufficiently high, and if not why not?

The quality of graduates in STEM subjects is quoted as an issue by many employers, with recruiters of the more specialised roles now searching for candidates at Masters level where previously a first degree would have sufficed. The HESA first destination figures for 2009/10 in science, mathematics and engineering graduates suggest a satisfactory level of success in securing employment or further study six months after the completion of their studies, at between 88% and 91%. This high employment percentage would imply that the STEM graduates are highly competitive in the current employment market.

UK HEIs deliver excellent value for money, being both highly productive and efficient. The proportion of our national income spent on our HEIs, at 1.2%, is similar to that of Germany and France, which spend 1.2% and 1.45% respectively and somewhat lower than the USA which spends 2.75%. The quality of the chemical research conducted in UK universities, which is performed in the main by postgraduate students who are themselves the output of undergraduate programmes of study, can be measured by the number of citations per article that they produce. Table 1 (see Appendix) shows that the UK, at 15 citations per publication, compares favourably to both Germany (14) and the USA (18.7).

A distinction should be made between education and training. While Higher Education Institutions (HEIs) provide an education for STEM graduates and ensure they have an appropriate level of knowledge and skill in a given subject area, a certain amount of additional industry-specific training will always need to be provided after graduation.

8. Do STEM graduates have the right skills for their next career move, be it research, industry or more broadly with the economy?

In 2010, six months after the completion of their studies 35.6% of chemistry graduates and 36.6% of physics graduates went into further education. The single biggest area of employment for chemistry graduates was scientific research (17.9%) while for physics graduates the most popular employment option was the business and finance work sector (16.2%). Almost 50% of chemistry graduates are working in a sector that is not R&D or further education, demonstrating that the skills they have acquired are recognised as important to other employment sectors.

The unemployment figures for STEM graduates are low when compared with other graduates (Figure 1) indicating that the skills STEM graduates acquire makes them competitive candidates for employment.

9. What effect will higher education reforms have on the quality of teaching, the quality of degrees and the supply of STEM courses in higher education institutes?

We have number of concerns. First, the cost of teaching chemistry was shown to be in excess of £12,000 per student in 2007. A student fee of £9,000 plus the HEFCE band B/Band C Differential of ca £1,500, is unlikely to cover the current cost of a chemistry degree.

Second, most chemistry students follow a 4-year integrated masters MChem programme of study, rather than a 3-year BSc. The MChem is considered the appropriate preparation for anyone wishing to follow postgraduate study or go into industry. However, it is unclear how the new fee structure will affect uptake on these courses; any student wishing to follow such a programme will accrue an additional year of debt of ca £18,000 in student loans (on top of the £50,000-60,000 for a 3-year programme).

Third, the Government has allocated 65,000 places to be made available for students achieving AAB grades or above (AAB+) at A-level or equivalent, and that initially, 20,000 places will be allocated to HEIs whose average charge is at or below £7,500. The core quotas for HEIs will be lowered according to the existing numbers of students achieving AAB+ equivalent, following which an HEI can freely recruit as many students at this level as it is able to attract and accommodate. With all HEIs competing freely for the students with the highest exam results of above AAB+ equivalent, there is a risk that some may prioritise the recruitment of high-performing students to non-science subjects where the cost of teaching is significantly lower. Will all A-level subjects be considered equal? Will subject combinations be taken into account? Will there be a differentiation between subjects that are more difficult relative to others? If not, this could lead to a decrease in the numbers of students taking science and mathematics subjects at A-level, for which the grading is more severe, if students, instead, choose to study other A-level subjects that may increase their chances of achieving AAB+ equivalent grades.

Fourth, the 20,000 places allocated to HEIs whose average charge is at or below £7,500 will either directly or indirectly adversely affect science places. The implication of this policy is that the national provision of science courses could reduce as certain HEIs take on more students in lower cost subjects. No university that teaches chemistry charges less than £8,500. Any reallocation of core places to those charging fees of £7,500 or less means that either (1) a direct loss of science places from universities charging higher fees, or (2) a loss of opportunity for those universities teaching science courses to cross-subsidise the provision of those courses. As the 20000 is set to grow in following years, this effect will only become exaggerated over time. For more on the thoughts of the RSC please refer to the RSCs joint response on this topic.[2]

In addition, sufficient capital funding must be made available to invest in teaching facilities and laboratories to ensure that they provide an experience that prepares students to enter the modern research and industry environment. It also needs to be recognised that if the AAB+ policy is to be properly implemented across STEM subjects capital infrastructure resource will be required. The ability to take additional students in the chemical sciences, and STEM subjects more widely, is restricted by the capacity of laboratory space and facilities that are available to any one institution.

10. What effect does "research assessment" have upon the ability to develop new and cross-disciplinary STEM degrees?

The effect of research assessment upon degree development is hard to assess. Research assessment has concentrated Funding Council derived research funds into fewer universities and tended to reduce the number of departments. However, there are of the order of 50 universities offering degrees in chemistry as a single discipline and over 80 offering courses that involve chemistry with other disciplines; these outnumber the 33 chemistry submissions made to the 2008 RAE exercise.

11. What is the relationship between teaching and research? Is it necessary for all universities to teach undergraduates and post graduates and conduct research? What other delivery model should be considered?

Two of the primary functions of a university are the generation (research) and dissemination (teaching) of new knowledge. A third is scholarship, which can encompass a range of activities, including: discipline-based investigation of published knowledge that extends an area of academic discipline; scholarship for teaching and learning including the investigation of pedagogy in relation to approaches to teaching, assessment and learning design; scholarship in support of professional practice.

Accordingly, undergraduate programmes of study in the chemical sciences include final year research projects that expose students to the research process; these projects not only prepare them for higher level study in the discipline, but also, through the development of generic research skills, for undertaking research projects in other areas of endeavour.

Moreover, particularly in the final year of study programmes, students are exposed to cutting edge research topics, in the main delivered by the scientists who are involved in the research themselves. Research and teaching are therefore inextricably linked and it is essential that this is reflected in the learning experience that is delivered to students.

This synergy between teaching and research demands a more coherent approach to the funding provided by higher education and research funding councils. For example, the former have been following a 'salami slicing' approach in their response to funding changes whereas the latter have followed an approach that concentrates funding in 'framework' universities (80% of EPSRC funding goes to 20 universities). The White Paper on HE Reform acknowledges that: "…this reform focuses on higher education teaching but our universities have a much wider role". By publishing the White Paper now and holding back its strategy for research and innovation to be published as a separate document later this year, the Government reveals its lack of joined-up thinking on this issue. In science subjects, one cannot divorce teaching from research. There is an intricate relationship between the two, in terms of space and facilities, financial sustainability, student contact with researchers, academic staff time and workload, and the supply chain of new researchers. Access to research facilities in undergraduate science programmes is needed even in teaching intensive departments. A more coherent approach to teaching and research in the sciences by the Government is essential.

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[2] The Royal Society of Chemistry, 2011, *A joint response from the Institute of Physics, the Royal Society of Chemistry, and the Society of Biology to the Department for Business, Innovation & Skills' consultation on the Higher Education White Paper.* http://www.rsc.org/images/JointHEWPresponse_tcm18-207596.pdf

Successive Research Assessment Exercises (RAEs) have had a major impact on reducing the number of chemistry departments in the UK as universities focused on research excellence.[3] Should the upcoming Research Excellence Framework exercise result in even further concentration of Research Council funding then it may be necessary to consider alternative models for provision of research and teaching. Consequently, we might expect a greater diversity in mission and profile of 'successful' chemistry departments, with a range of USPs, and a wider mix of teaching/scholarship, full time/part time, RCUK/industry research income etc. Flexibility will be key, not necessarily the size of department. It will be increasing important for departments to have a broad range of income streams so that they become less dependent on one funding source.

12. Does the UK have a sufficient geographical spread of higher education institutions offering STEM courses?

Applications for the STEM subjects for each region of the UK, and the population that live in that region are shown in Table 2.

There is some variability in the level of access in all the UK regions for STEM courses at undergraduate level. This is best indicated by the ratio of acceptances onto chemistry undergraduate courses compared to population (Table 2, final column). The eastern region of England appears to be significantly lower than the national average. The current level of regional accessibility to chemistry undergraduate degrees needs to be maintained at least at its current level, to ensure that chemistry is accessible for all prospective students. This is especially so in a fee environment that is likely to result in students choosing a university that is close to their parental home. However, given the importance of chemistry undergraduates and the chemical industry to the UK economy, the current level of availability of chemistry courses is the minimum acceptable.

As well as a sufficient geographical spread, there is also a need for a sufficient spread of flexible approaches to study that encompass both full- and part-time, and also a mixture of the two. The Open University 'OpenPlus' scheme which partners with 15 other universities is an example of one such approach.

13. What is being done and what ought to be done to increase the diversity of STEM graduates in terms of gender, ethnic origin and socio-economic background?

The STEM workforce is not yet truly representative, with a significant gender imbalance in many areas. Chemistry is one of the STEM subjects with a more even distribution of males and females. In 2011, of the 142000 GCSE chemistry candidates 47% were female, and of the 4800 A-level chemistry candidates 47% were female. In 2010, at undergraduate level, of the 4300 entrants to chemistry courses 41% were female, while at postgraduate level 39% of the 1025 PhD starters were female.

In undergraduate chemistry, black Caribbean students are significantly under-represented relative to the overall numbers in the population. In contrast, Indian and Chinese students are more likely to read undergraduate chemistry than white students: Indian students are twice as likely, and Chinese students are three times as likely.[4]

It is difficult to accurately predict how the current the economic climate will affect the behaviour on the pattern of study of chemistry by those from varying economic backgrounds. The RSC is eager to see investigated the effects that the current economic climate and the changes to tuitions fees are likely to have on student attitude to studying chemistry.

14. Is the current training of PhD students sensitive to the range of careers they subsequently undertake?

PhD students now receive a broad range of training that encompasses career-transferable skills alongside discipline- and project-specific knowledge and skills. The Vitae programme supported by RCUK and delivered by CRAC ensures that standards are set for universities and supervisors in this regard.

By giving PhD students good and clear career advice we give them the opportunity to tailor their studies to ensure that they have the best chance to achieve a successful career in their preferred employment area. A PhD in chemistry for example will focus the skills and training for a career in R&D, but there should be room for any PhD student to acquire additional, career relevant skills.

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[3] The Royal Society of Chemistry, 2006, *Reform of Higher Education Research Assessment and Funding.* http://www.rsc.org/images/RSCfinal%20Response_tcm18-66616.pdf

[4] The Royal Society of Chemistry and The Institute of Physics, 2006, *Representation of Ethnic Groups in Chemistry and Physics. http://www.rsc.org/images/Ethnic%20Web_tcm18-53629.pdf*

The vast majority of final-year students at PhD level, report that they do want to pursue a career related to their degree subject, although that proportion varies somewhat with degree subject. As many as two-thirds of those in engineering definitely want a degree-related career, but nearer to half of those in chemistry and physics desire to work in careers related to their degree area.

15. Are we currently supporting the right number of PhD studentships to maintain the research base and are they of sufficient quality?

The number of full-time chemistry PhD students starting in 2009/10 was 1025, up from 945 in 2007/8. Of these 1025, 675 were from the UK, 130 from the EU, and 220 were international.

As shown in Table 1, the quality of the publication output (largely achieved by postgraduate students) matches competitor nations, as measured by the average number of citations per paper published.

Only 10.3% of physical science postgraduates are unemployed, a number which compares favourably to other subjects. This indicates that the quality of STEM graduates is high enough to enable them to compete with graduates in other subject areas.

A number of employers have stated that not only is it becoming harder to find STEM graduates, it is also harder to find good quality STEM post-graduates. To address this situation employers and universities need to open direct lines of communication so both parties are working together to produce and employ a well-trained and highly-knowledgeable workforce.

16. What impact have Doctoral Training Centres had on the quality and number of PhD students? Are there alternative delivery models?

There are some very successful Doctorial Training Centres (DTC) in chemistry. We have received anecdotal comment from departments that host such centres that there is no difference between the training offered to those in a DTC and those who aren't.

A major issue is the impact that several EPSRC policy decisions have had on the landscape of PhD training in chemistry. DTC's were instituted when a significant proportion of postgraduate training was delivered through studentships attached to project grants. In future, no studentships will be available through EPSRC project grants. This shift can be seen through the following numbers. Five years ago there were around 2500 physical sciences postgraduate students hosted by project training grants, 5000 by Doctoral Training Accounts (DTAS) and 800 Industrial CASE students. Currently there are 5000 studentships in Doctoral Training Accounts, 2500 supported in Doctoral Training Centres and there are still around 800 Industrial CASE awards. Thus, there has been a shift of about 30% of the available studentships from support through project grants to support through Doctoral Training Centres. However, the distribution of DTCs, both in terms of areas of science and also geographical location, is rather skewed. For example, there is no Doctoral Training Centre in a chemical science subject in Scotland, and only one, in Bristol, for synthetic organic chemistry, a major UK strength.

The current landscape of postgraduate training in chemistry is not one that reflects any sense of a national strategy. The RSC is eager to facilitate the development of such a strategy that involves all stakeholders.

17. Should state funding be used to promote Masters Degrees and is the balance right between the number of Masters Degree students and PhD students?

The HESA data for 2009/10 indicate that 67% of postgraduates in chemistry are undertaking doctorate training; this seems appropriate. The type of independent, innovative and analytical skills developed in the PhD is vital to UK plc. The integrated masters (MChem) plays a critical role in preparing students for research, while taught masters (MSc) address the niche markets of employment sectors that require employees with specific skills in areas not covered in the standard chemistry syllabuses, e.g. nuclear chemistry and advanced analytical science. State funding, for both students and departments is essential for maintaining this skills pipeline.

18. What impact will higher education reforms have on the willingness of graduates to pursue a research career?

We believe that it is too early to offer a definitive judgement on the full impact of the higher education reforms but the following should be noted:

- The four-year integrated Masters degree – the MPhys/MChem/MBiol/MSci – is now the norm for those considering a career in university or industrial R&D, as it is the preferred route to professional recognition and PhD entry. Financial constraints are certainly a factor in some able students choosing to study a three-year degree, and not taking-up the extra year which means another year

of debt accumulation. HEFCE teaching funding provision should ensure that science departments can continue to offer four-year courses.
- In addition, PhD courses which are essential to certain industrial and academic sectors now generally take four years. During this time, loans from earlier study are accruing additional interest. This could have negative impact on future student choice to take up postgraduate research. It is therefore essential that the Government monitors the impact of the new fees regime on the uptake of postgraduate study.

19. What incentives should industry offer STEM graduates in order to attract them?

Employers seem ready to offer competitive salaries to STEM subject graduates although HESA data shows that those that have studied engineering disciplines dominate the top earning STEM graduates. R&D in sectors such as pharmaceuticals and electronics do attract good numbers of applicants, but the manufacturing and materials areas have much more difficulty. Salaries offered by the financial services sector, where many STEM graduates can and do thrive, have outcompeted the commercial and academic sectors substantially for some time. Some STEM graduates will continue to be drawn there. However, it is not just the salary that deters them – as one employer puts it “either they want to do engineering, or they don’t and can’t be persuaded”.

Professional career paths and growth structures can be designed for those that do choose a technical career, so that they can advance without needing to move into large managerial roles. In addition, industry and HEIs could collaborate more to offer industrial placements as part of degree programmes to develop work-related skills.

20. What steps are industry and universities taking together to ensure that demand for STEM graduates matches supply in terms of numbers, skills and quality of graduates?

The RSC believes that there are a number of good schemes being run around the UK to help get industry engaged with students, such as the Industrial Advisory Boards (IABs), but there appears to be a lack of a national strategy. The year-in-industry placements that are available appear to have been poorly populated and efforts should be made to address this, as these placements are excellent learning opportunities.

The question of curriculum development in the STEM subjects in higher education has a substantial bearing on employer involvement. Larger employers commonly have a series of links with academic departments, offering the opportunity to contribute to course design. Some report that HEIs are slow to take up the offer, and note the contrast with American universities which use such collaboration as a feature of their marketing to prospective students.

The EU platform for sustainable chemistry, SusChem, and the European Chemical Industry Council, Cefic, are investigating the need to build skills capacity to achieve a sustainable chemical industry sector. One outcome from this is the need for chemistry degree programmes to develop competencies that will enable graduates to function in a broad range of industries associated with chemical endeavours, and not to have too narrow a focus.

Appendix

Figure 1 HESA employment data for a range of undergraduate degree subjects.

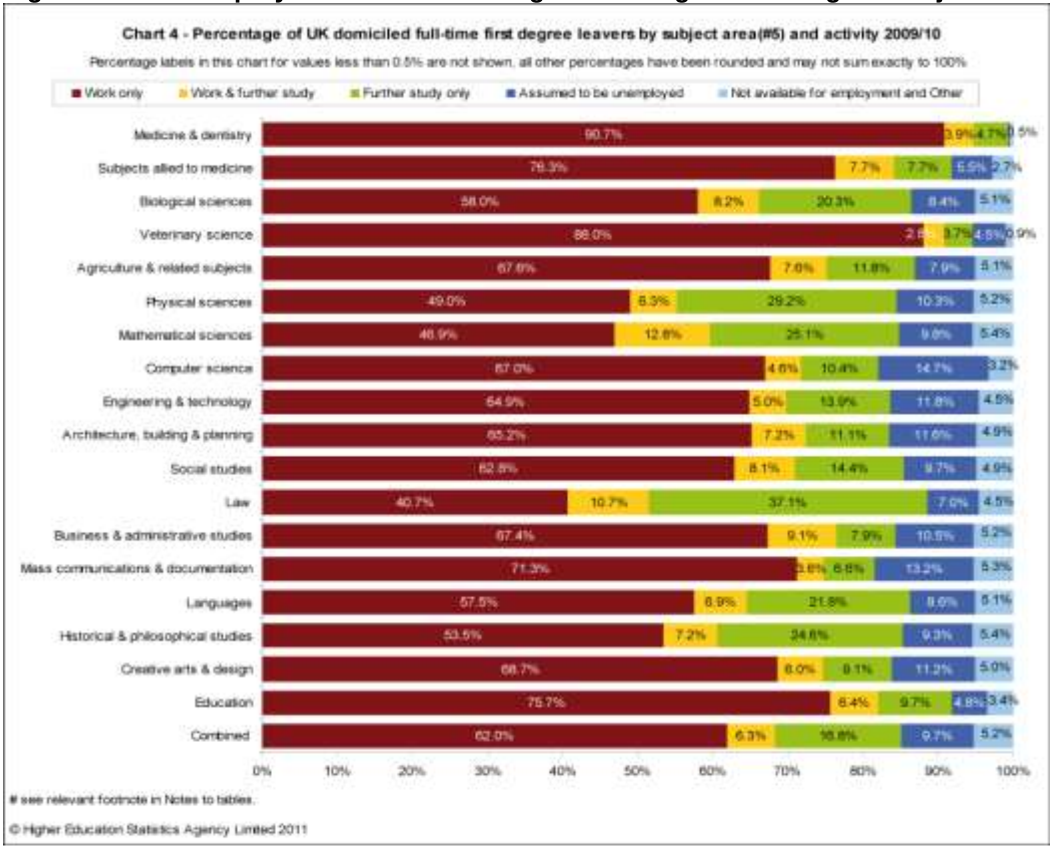


Figure 2 HESA data on the importance of the undergraduate degree taken different job sectors.

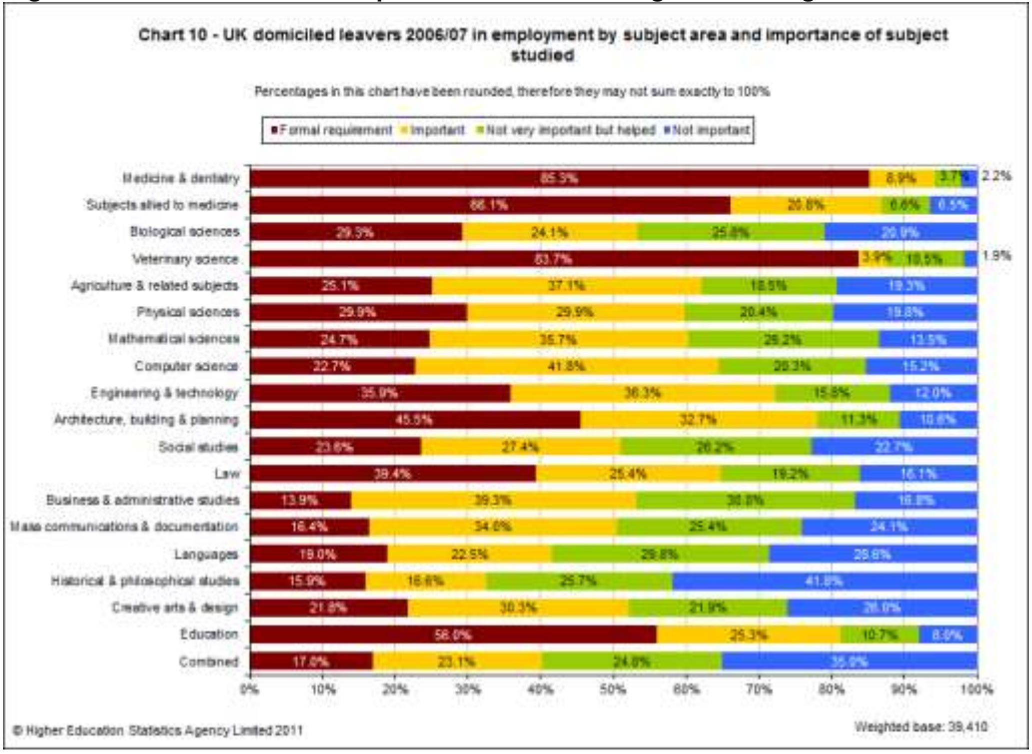
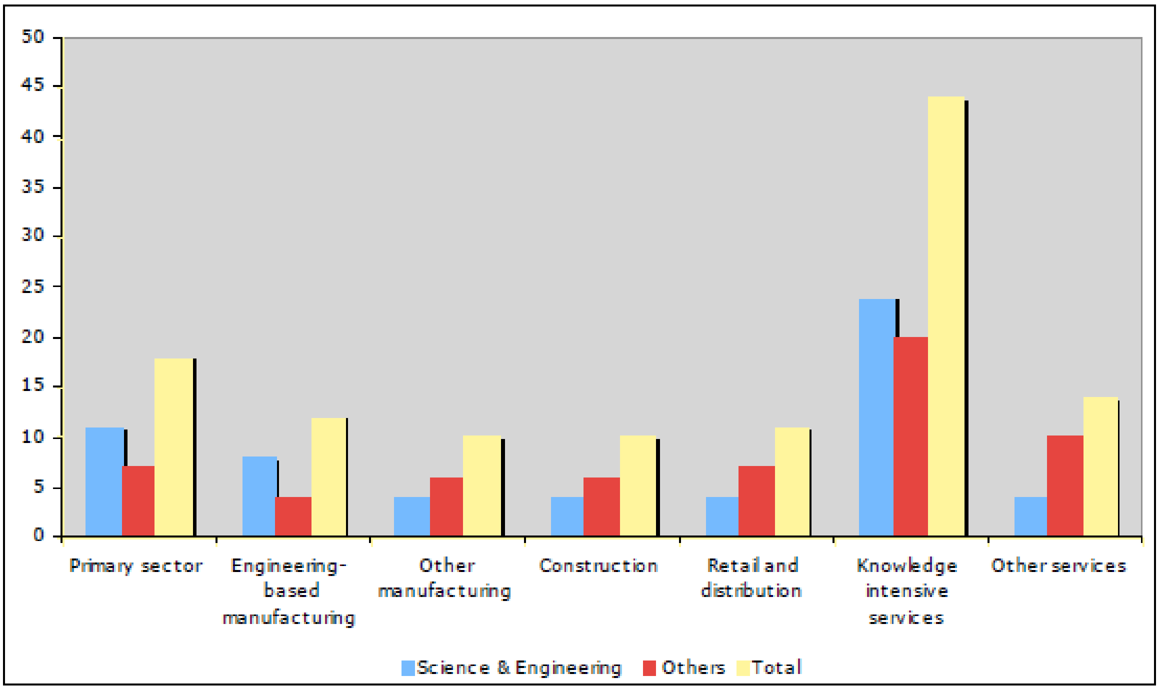


Figure 3 DTI data showing the range of careers of STEM graduates.

Chart 1: Average number of employees (%) educated to degree level in science and engineering



Source: DTI Occasional Paper No. 6, Innovation in the UK: Indicators and Insights, July 2006.

Figure 4 The number of students taking chemistry A-Level

A-Level entries

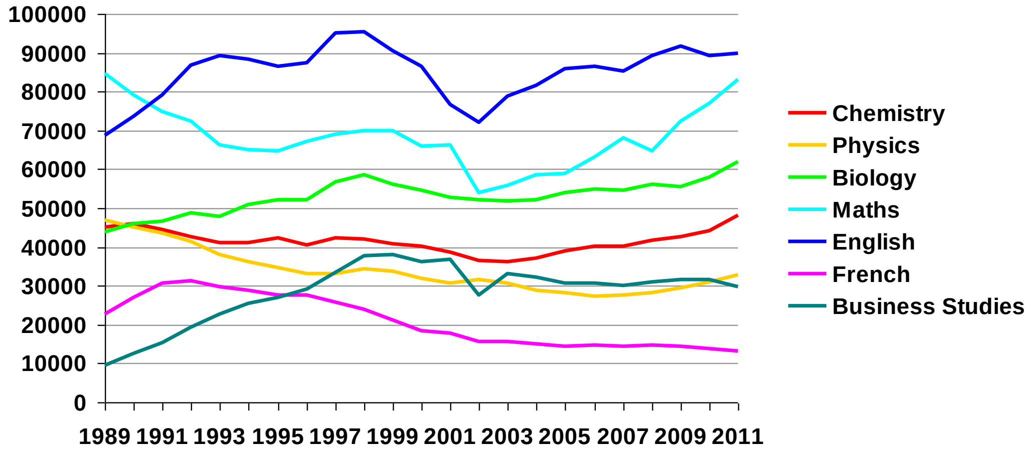


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Figure 5 The number of applications and acceptances to study chemistry at UK HEIs (HESA data)

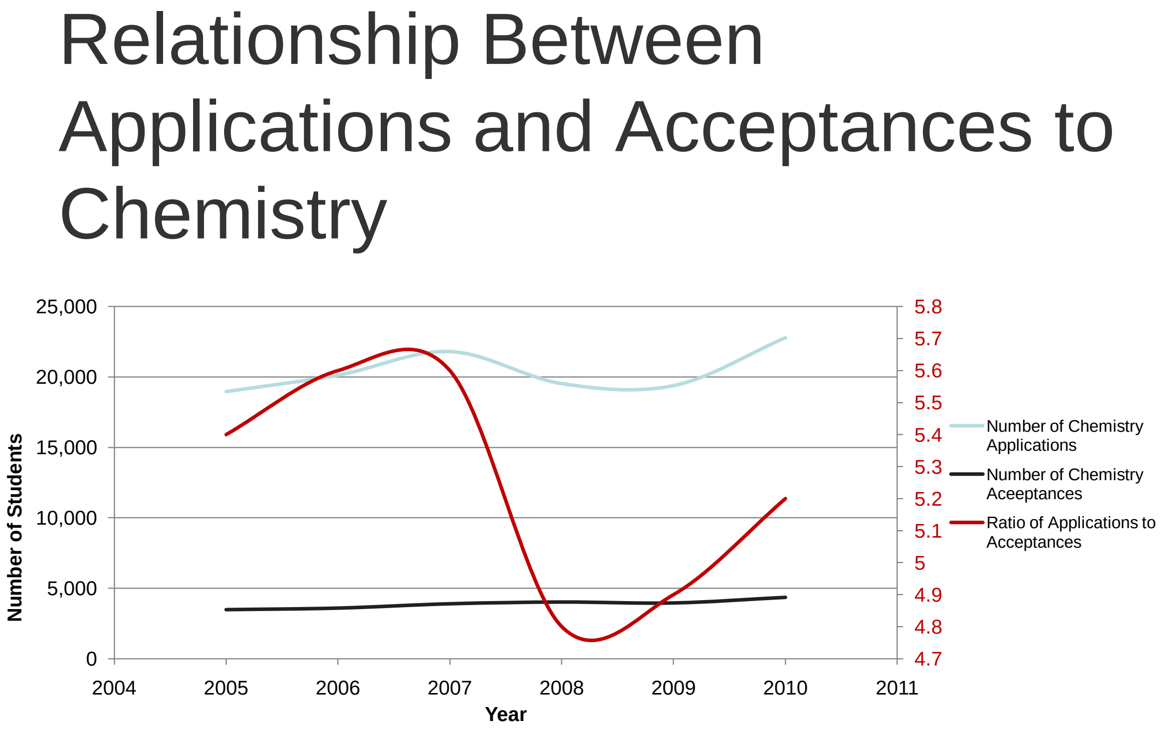

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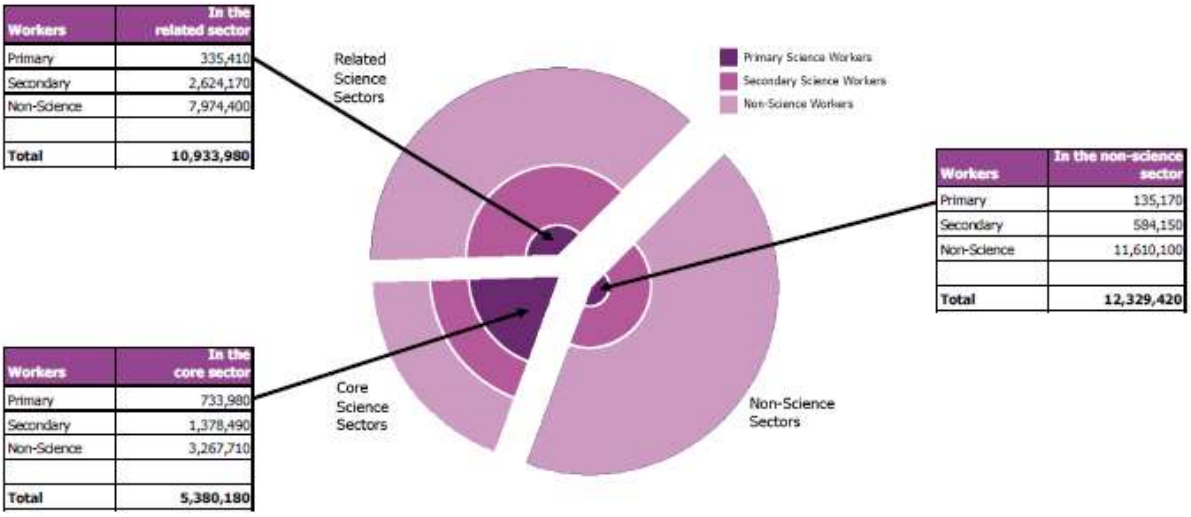
Figure 6 Work sectors of STEM graduates: core – science knowledge required; related – science knowledge helpful; non-science – science knowledge unnecessary)



Workers	In the related sector
Primary	335,410
Secondary	2,624,170
Non-Science	7,974,400
Total	**10,933,980**

Workers	In the core sector
Primary	733,980
Secondary	1,378,490
Non-Science	3,267,710
Total	**5,380,180**

Workers	In the non-science sector
Primary	135,170
Secondary	584,150
Non-Science	11,610,100
Total	**12,329,420**

Table 1 Articles produced and citations received for the UK, Germany and the US.

Year 2001-2011	**UK**	**USA**	**Germany**
No of articles	65,558	222,750	93,739
No of Citations	984,674	4,158,156	1,304,024
Average Citation per article	15.02	18.67	13.91

Table 2 Acceptances to STEM undergraduate course per region of the UK, compared to the population of each region.

	Acceptances						
Region	*Biological Sciences*	*Physical Sciences*	*Maths & Computer Science*	*Engineering*	*Total*	*Population/ Million*	*10^3 x Acceptances/ Population*
Scotland	3134	1554	2488	2982	10158	5.25	1.94
Wales	2499	957	952	960	5368	3.0	1.79
Northern Ireland	632	377	806	620	2435	1.75	1.39
East Midlands	2180	1155	1711	1976	7022	4.25	1.65
Eastern	1383	400	1573	811	4167	5.5	0.76
Greater London	3564	1201	4591	3773	13129	7.25	1.81
North East	1746	849	1466	906	4967	2.5	1.99
North West	3633	1718	2675	1957	9992	7.0	1.43
South East	2966	1886	2747	1973	9572	8.25	1.16
South West	2540	1424	1759	1531	7254	5.0	1.45
West Midlands	2333	1024	2291	1898	7546	5.25	1.44
Yorkshire & the Humber	3265	1408	2512	2575	9760	5.25	1.86
Total	29884	13953	25571	21962	91370	60.25	1.52